

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Yun Soo CHOE et al.

Serial No. 10/652,493

Group Art Unit: 3742

Confirmation No. 2730

Filed: September 2, 2003

Examiner: Sang Yeop Paik

For: HEATING CRUCIBLE FOR ORGANIC THIN FILM FORMING APPARATUS

REPLY BRIEF

Mail Stop Appeal Brief—Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Reply Brief is being filed under 37 CFR 41.41 in response to the Examiner's Answer mailed July 24, 2007, and having a period for response set to expire on September 24, 2007, under 37 CFR 41.41(a)(1).

An Amendment After Appeal Under 37 CFR 41.33(b)(2) rewriting allowable claim 28 in independent form is being filed with this Reply Brief.

A Petition Under 37 CFR 1.181(a) For Designation of Ground of Rejection in Examiner's Answer as New Ground of Rejection is being filed with this Reply Brief.

The Examiner cited three new references (i.e., U.S. Patent Nos. 6,030,458, 5,034,200, and 4,511,612) in the Examiner's Answer of July 24, 2007, but did not list these references on a form PTO-892. Accordingly, it is respectfully requested that the Examiner provide a form PTO-892 listing these references with the response to this Reply Brief.

The sections of this Reply Brief have the same numbers as the corresponding sections of the Appeal Brief of April 19, 2007, but only those sections that have changed are included in this Reply Brief.

A copy of pyrolytic boron nitride data (14 pages) is attached following page 33 of this Reply Brief and is discussed below in Section VII—Argument with respect to the rejection of claims 1 and 23.

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III. STATUS OF CLAIMS (UPDATED)

The following status of the claims presumes that the Amendment After Appeal Under 37 CFR 41.33(b)(2) being filed with this Reply Brief will be entered.

Claims 1-4 and 7-31 are pending, with claims 1 and 28 being independent.

Claims 5 and 6 have been canceled.

Claim 28 stands objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 28 has been rewritten in independent form in the Amendment After Appeal Under 37 CFR 41.33(b)(2) that is being filed with this Reply Brief, and thus should now be in condition for allowance.

Claims 1-4, 7-27, and 29-31 stand rejected.

Claims 1-4, 7-27, and 29-31 are on appeal.

IV. STATUS OF AMENDMENTS (UPDATED)

An Amendment After Final Rejection was filed on February 7, 2006, in response to the Final Office Action of November 17, 2005.

In the Advisory Action of March 1, 2006, the Examiner indicated that, for purposes of appeal, the Amendment After Final Rejection of February 7, 2006, would be entered.

A Request for Continued Examination (RCE) and an Amendment were filed on March 16, 2006, in response to the Advisory Action of March 1, 2006. On page 1 of the Amendment of March 16, 2006, the applicants requested that the Amendment After Final Rejection of February 7, 2006, not be entered. The Amendment of March 16, 2006, amended the application as it appeared prior to the Amendment After Final Rejection of February 7, 2006.

On page 7 of the Amendment of July 27, 2006, and page 6 of the Request for Reconsideration After Final Rejection of December 11, 2006, the applicants pointed out that the image file wrapper of the application indicates that the Amendment After Final Rejection of February 7, 2006, is to be entered, and requested that the Examiner have the image file wrapper of the application corrected to indicate that the Amendment After Final Rejection of

February 7, 2006, is not to be entered. In response to these requests, the Examiner stated as follows in the Advisory Action of January 4, 2007:

It is also noted that the amendment after final mailed on 2/7/06 is properly considered and entered by the examiner. No request was made at that time by the applicant whether to enter or not enter the paper mailed on 2/7/06. However, it is noted that after the prosecution is closed, it is the examiner's discretion whether to enter [sic] the response [sic] or not, and once it is entered, it would not be made un-entered.

However, the Advisory Action of March 1, 2006, indicated that the Amendment After Final Rejection of February 7, 2006, would be entered for purposes of appeal, and the applicants did not pursue an appeal at that time, but filed the Request for Continued Examination (RCE) and the Amendment of March 16, 2006, in which they requested that the Amendment After Final Rejection of February 7, 2006, not be entered. Furthermore, MPEP 706.07(h)(III)(D) provides that "[i]f conflicting amendments have been previously filed, applicant should clarify which amendments should be entered upon filing the RCE."

Nevertheless, it appears that this issue is essentially moot for the following reasons. The Amendment After Final Rejection of February 7, 2006, presented amendments to the drawings and arguments. The Amendment of March 16, 2006, repeated the amendments to the drawings and the arguments that were presented in the Amendment After Final Rejection of February 7, 2006, and also presented amendments to the specification and the claims and additional arguments. Accordingly, it is submitted that the current state of the application would be the same regardless of whether the Amendment After Final Rejection of February 7, 2006, has been entered.

A Request for Reconsideration After Final Rejection that did not present any amendments but presented only arguments was filed on December 11, 2006, in response to the Final Office Action of October 12, 2006.

In the Advisory Action of January 4, 2007, the Examiner stated that "[t]he reply filed 11 December 2006 fails to place this application in condition for allowance," and that "[t]he request for reconsideration has been considered but does NOT place the application in condition for allowance because: the applicant's arguments are not deemed persuasive."

An Amendment After Appeal Under 37 CFR 41.33(b)(2) rewriting allowable claim 28 in independent form is being filed with this Reply Brief. It is presumed that this Amendment After Appeal Under 37 CFR 41.33(b)(2) will be entered.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL (UPDATED)

1. Whether claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31 are unpatentable under 35 USC 103(a) over Chow (U.S. Patent No. 5,157,240) in view of Chandler (U.S. Patent No. 2,799,764) or Isaacson et al. (Isaacson) (U.S. Patent No. 3,842,241).
2. Whether claims 3, 14, and 19 are unpatentable under 35 USC 103(a) over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31, and further in view of Kano et al. (Kano) (U.S. Patent No. 6,242,719).
3. Whether claims 8, 15, and 26 are unpatentable under 35 USC 103(a) over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31, and further in view of Bichrt (U.S. Patent No. 6,162,300).
4. Whether claim 10 is unpatentable under 35 USC 103(a) over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 20-25, and 29 (presumably intended to be claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31), and further in view of Okuda et al. (Okuda) (U.S. Patent No. 4,804,823).
5. Whether claim 20 is unpatentable under 35 USC 103(a) over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 20-25, and 29 (presumably intended to be claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31), and further in view of Takagi (U.S. Patent No. 4,217,855).
6. Whether claim 27 is unpatentable under 35 USC 103(a) over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31, and further in view of Chen et al. (Chen) (U.S. Patent No. 6,024,799) or Murakami et al. (Murakami) (U.S. Patent No. 5,728,223).

VII. ARGUMENT (ADDITIONAL)

This section contains only additional arguments responding to the new arguments presented by the Examiner on pages 8-13 of the Examiner's Answer of July 24, 2007. These additional arguments supplement the arguments in Section VII—Argument on pages 10-41 of the Appeal Brief of April 19, 2007.

Rejection 1—Claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31

Claims 1 and 23—"heat-resistant layer" features

On pages 8 and 9 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

The applicant argues Chow, Chandler, and Isaacson do not disclose or teach the recited "heat-resistant layer formed on a surface of the cover heater." The applicant argues that the layer (25, 25') shown in Chow is not a "heat-resistant layer" but is rather a protective layer that shows nothing whatsoever as the "heat-resistant layer." The applicant's argument is not deemed persuasive. The term "heat-resistant" is such a broad terminology. The examiner has raised the broadness of such term in the non final office action mailed on 5/2/06 as well as in the final office action 10/12/06 and discussed that a "heat-resistant layer" can be broadly interpreted as any layer that "impedes a heat transfer." Furthermore, the examiner's interpretation of the "heat-resistant material" is also based on the applicant's own disclosure wherein it states that the "heat-resistant layer" is a thin film type (see page 7, paragraph 35). It is noted that the applicant has not disclosed any other structure or material in relation to the heat-resistant material. Thus, interpreting the claims and its scope in light of the applicant's specification, the examiner has interpreted the Chow layer (25, 25'), which is a thin layer type made of pyrolytic boron nitride, as the recited "heat-resistant layer". The examiner's interpretation of the "heat-resistant material" as the layer that impedes a heat transfer is also deemed reasonable in light of the applicant's newly submitted English translation of Korean priority document 2002-52898 which refers the "heat-resistant layer" as an "adiabatic layer" that "block transmission of heat."

The applicant argues that such interpretation is unreasonable because it ignores the limitation of "heat-resistant" in the "heat-resistant layer." The applicant seems to suggest that since Chow calls the layer as "protective layer", it can only serve

or function as a protective layer and no other purpose. However, it is noted that there is a well established controlling authority that when the structure or material recited in the prior art is substantially identical to that of the claims, the claimed properties or functions are assumed to be inherent. In this case, the recited structural limitation of the "heat-resistant layer" is a layer which is disclosed as a thin film type, and Chow which clearly shows such recited structural limitation, the recited "heat-resistant" property is deemed inherent.

However, the Examiner has not identified the "well established controlling authority" upon which he has relied, which makes it difficult for the applicants to respond to the rejection. Furthermore, the Examiner has apparently lost sight of the fact that the structural limitation that is disclosed in the applicants' specification and recited in claims 1 and 23 is a heat-resistant layer, not a thin film. The mere fact that paragraph [0035] of the specification discloses that the heat-resistant layer recited in claims 1 and 23 is formed as a thin film type does not somehow convert the structural limitation of a heat-resistant layer recited in claims 1 and 23 into a thin film. Nor does the mere fact that Chow's protective layers 25' and 25 are made of pyrolytic boron nitride from 1.0 to a few mils thick somehow make Chow's protective layers 25' and 25 a heat-resistant layer as recited in claims 1 and 23 as alleged by the Examiner.

It is submitted that whether a layer is a heat-resistant layer as recited in claims 1 and 23 depends, for example, at least on what the layer is made of, and how thick the layer is. Here, the Examiner has not provided a basis in fact and/or technical reasoning as required by MPEP 2112(IV) and *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990), to reasonably support his determination that Chow's protective layers 25' and 25 made of pyrolytic boron nitride from 1.0 to a few mils thick are inherently a heat-resistant layer as recited in claims 1 and 23, or an adiabatic layer that blocks transmission of heat. Rather, the Examiner's determination is based solely on the fact that paragraph [0035] of the applicants' specification discloses that the heat-resistant layer recited in claims 1 and 23 is formed as a thin film type, and that Chow's protective layers 25' and 25 made of pyrolytic boron nitride are from 1.0 to a few mils thick. The Examiner concludes that since the heat-resistant layer recited in claims 1 and 23 is disclosed as being a thin film type and Chow's protective layers 25' and 25 are thin layers, then Chow's protective layers 25' and 25 are also a heat-resistant layer as recited in claims 1 and 23. Thus, the Examiner has improperly interpreted the structural limitation of a heat resistant layer recited in claims 1 and 23 as if it were merely a thin layer.

On page 9 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

The applicant further raises a new argument that it is known in the art that the protective layer of Chow which made of pyrolytic boron nitride is a material of a very high thermal conductivity and, as such, the pyrolytic boron nitride transmits heat rather than blocks it. However, contrary to the applicant's argument, it is known in the art that the pyrolytic boron nitride material is a high temperature/heat resistant material as shown in US Patent Nos. 5,034,200 (see column 7, lines 9-14), 6,030,458 (see column 2, lines 15-18), and 4,511,612 (see column 3, lines 13-25). Thus, the applicant's argument is not deemed persuasive.

Column 7, lines 9-14, of U.S. Patent No. 5,034,200 (Yamashita) relied on by the Examiner reads as follows:

It is possible to use a heat resistant material other than quartz, such as Pyrolytic Boron Nitride (PBN), Si_3N_4 , or SiC, as the material of the crucible (1, 4, 34), small chamber 7 and pipe 6. Further, it is possible to coat the surface of the crucible, small chamber and pipe with PBN, Si_3N_4 , or SiC.

Column 2, lines 15-18, of U.S. Patent No. 6,030,458 (Colombo) relied on by the Examiner reads as follows:

Solid-source valved cracker sources have previously used a conventional cracking tube that consists of a high temperature resistant tube (tantalum, tungsten, PBN, graphite, molybdenum) that was heated from an exterior heater.

However, it is submitted that the terms "heat resistant material" and "high temperature resistant tube" in these portions of Yamashita and Colombo merely refer to the fact that pyrolytic boron nitride has a high melting temperature. It is not seen where anything whatsoever in Yamashita and Colombo indicates that pyrolytic boron nitride blocks transmission of heat, which is the meaning of "heat-resistant" in the term "heat-resistant layer" in claims 1 and 23 as discussed on pages 13-15 of the Appeal Brief of April 19, 2007.

Column 3, lines 13-25, of U.S. Patent No. 4,511,612 (Hüther) relied on by the Examiner reads is part of a longer passage in column 3, lines, 11-25, of Hüther, which reads as follows:

The insulating ceramic intermediate layer is provided especially because of the lower resistance to temperature and more pronounced thermal expansion. The ceramic materials of the ceramic inner layer exhibit a high degree of temperature

resistance and high resistance to wear or abrasion and carbon fiber reinforced graphite, when used for the retaining layer, exhibits great tensile strength. Materials which can be used for the intermediate layer include lithium aluminum silicate (LAS), magnesium aluminum silicate (MAS), aluminum titanate (AlTiO_3) or pyrolytic boron nitride (BN). These materials afford good thermal insulation. The fiber reinforced material (embedding material or matrix) of the retaining layer, more particularly, is preferably an organic material or metal.

Another relevant passage of Hüther appears to be column 2, lines 43-55, which reads as follows:

The retaining layer can also be given a high modulus of elasticity, extremely little thermal expansion, and relatively high thermal resistance. If it is intended to give the wall thermally insulating properties, the insulating ceramic intermediate layer is provided between the two other layers. The intermediate layer operates to reduce thermal conductance to the outside and so retains the heat internally, preventing the retaining layer from overheating and losing strength. It is because of this intermediate layer that the wall when under thermal load can be held at a temperature which the material of the retaining layer will safely sustain at not more than modest cooling effort.

Another relevant passage of Hüther appears to be column 3, line 66, through column 4, line 5, of Hüther, which is part of the detailed description of the drawing of Hüther and reads as follows:

The chamber, or its wall, consists of a heat resistant, ceramic inner layer 10 of silicon carbide (SiC) or silicon nitride (Si_3N_4), of a thermally insulating ceramic layer 11 of magnesium aluminum silicate (MAS) and of a retaining layer 12 of carbon fiber reinforced graphite. Layer 11 can also be formed of lithium aluminum silicate (LAS), aluminum titanate (AlTiO_3) or pyrolytic boron nitride (BN).

Column 5, lines 43 and 44, of Hüther appears to describe an example in which the thermally insulating ceramic layer 11 is a pyrolytic boron nitride layer 20 μm thick, which is about 0.0008 inches, or 0.8 mil, which is less than the thickness of 1.0 to a few mils of Chow's protective layers 25' and 25 that are made of pyrolytic boron nitride.

The above passages of Hüther may arguably appear to indicate that pyrolytic boron nitride, the material of which Chow's protective layers 25' and 25 are made, provides good thermal insulation. However, it submitted that this appears to be factually incorrect in light of

column 4, lines 46-60, of U.S. Patent No. 4,264,803 to Shinko (newly cited by the applicants in this Reply Brief), which reads as follows (emphasis added):

The pyrolytic boron nitride coating conducts heat from the graphite bar to the metal in the cavity effectively but since pyrolytic boron nitride has low emissivity compared to the intermetallic composites now used for boats it radiates less energy. The metal vaporized in the boats is electrically isolated from the circuit and chemically isolated from the graphite resistor. Thus, the resistance of the boat/metal system is that of the graphite alone and since the graphite is chemically isolated from the metal, its resistance does not change, so that minimal power adjustments are required during operation. The thermal conductivity of pyrolytic boron nitride is very high along the length of the graphite bar which insure a uniform temperature and more uniform vaporization.

Thus, the pyrolytic boron nitride coating 10 in FIGS. 1, 2, 3, and 3A of Shinko is a good conductor of heat both in a direction perpendicular to the graphite bar and in a direction parallel to the graphite bar.

Column 3, lines 23-26, of Shinko reads as follows:

The coating of pyrolytic boron nitride achieved by the invention should be at least 0.010 inches [10 mils] in thickness and most preferably at least 0.020 inches [20 mils]. A preferred range is from 0.015 to 0.030 inches [15 to 30 mils].

The thicknesses in this passage of Shinko are greater than the thickness of 1.0 to a few mils of Chow's protective layers 25' and 25 that are made of pyrolytic boron nitride.

Attached hereto is a copy of pyrolytic boron nitride data (14 pages) downloaded on August 23, 2007, from the Morgan Advanced Ceramics Web site at <http://www.morganadvancedceramics.com/materials/pbn.htm>. Page 9 of this data states as follows:

Performance PBN's thermal conductivity in the "a" direction is similar to that of cast iron, surpassing that of beryllia. For this reason, the compound can conduct heat while acting as an electrical insulator. Thermal conductivity in the "a" direction is almost 66 times greater than thermal conductivity in the "c" direction. Conductivity in the "c" direction increases slightly with increasing temperatures.

In light of this statement in the pyrolytic boron nitride data, as well as the portions of Shinko discussed above, it is submitted that pyrolytic boron nitride in fact conducts heat, rather than blocking transmission of heat, which is the meaning of "heat-resistant" in the term "heat-resistant layer" in claims 1 and 23 as discussed on pages 13-15 of the Appeal Brief of April 19, 2007. Accordingly, it is submitted that Chow's protective layers 25' and 25, which are made of pyrolytic boron nitride 1.0 to a few mils thick, conduct heat, and thus are not a heat-resistant layer as recited in claims 1 and 23.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 10-15 of the Appeal Brief of April 19, 2007, it is submitted that the Chow's protective layers 25' and 25 are not a "heat-resistant layer" as recited in claims 1 and 23 as alleged by the Examiner.

Claims 1 and 24—"reflective layer" features

Chandler

On pages 9 and 10 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to Chandler, the applicant argues that the layer (78) in Chandler is made of "paper, paperboard, cloth, or other suitable material", and such material is not a heat-resistant but nothing more than backing layer as Chandler intended to apply. As in the final office action, the examiner has raised the issue that it is notoriously known that paper and cloth can be a heat-resistant material as it is experienced in daily livelihood where a paper towel or cloth is used as a heat-resistant material to hold and removed [*sic*] a hot pan off a stove. This example is shown to provided [*sic*] that materials such as paper and cloth can be a heat-resistant material/layer.

It is noted, however, that Chandler is applied to teach the recited reflective layer and not a heat resistant layer, and Chandler clearly shows the reflective layer as the element (62) that is disposed between a heating element and a heat resistant layer 78.

The Examiner has cited Chandler to show that it was known in the art to place a reflective layer between a heater and a heat-resistant layer as recited in claims 1 and 24. However, if one of ordinary skill in the art would not have recognized that Chandler discloses a heat-resistant layer as recited in claims 1 and 24, then Chandler cannot teach that it was known

in the art to place a reflective layer between a heater and a heat-resistant layer as recited in claims 1 and 24 as alleged by the Examiner. Here, the Examiner has taken the position that the backing layer 78 in FIG. 5 of Chandler is a heat-resistant layer as recited in claims 1 and 24 because column 7, lines 35-38, of Chandler, states that the backing layer 78 may be made of paper, paperboard, cloth, or other suitable material, and the Examiner is of the opinion that it is notoriously well known that paper and cloth can be a heat-resistant material since, for example, a paper towel or cloth can be used as a heat-resistant material to hold and remove a hot pan from a stove.

However, the Examiner has not identified anything whatsoever in Chandler or elsewhere in the prior art to indicate that one of ordinary skill in the art would have recognized that Chandler's backing layer 78 made of paper, paperboard, cloth, or other suitable material can be a heat-resistant layer as recited in claims 1 and 24. Rather, the only suggestion that Chandler's backing layer 78 can be a heat-resistant layer as recited in claims 1 and 24 is contained in the applicants' disclosure. Accordingly, it is submitted that the Examiner's position that Chandler's backing layer 78 made of paper, paperboard, cloth, or other suitable material can be a heat-resistant layer as recited in claims 1 and 24 because it is notoriously well known that paper and cloth can be a heat-resistant material since, for example, a paper towel or cloth can be used as a heat-resistant material to hold and remove a hot pan from a stove is based solely on an impermissible hindsight reconstruction of the invention arrived at by reading the applicants' disclosure.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 15-18 of the Appeal Brief of April 19, 2007, it is submitted that Chow and Chandler do not disclose or suggest "a reflective layer between the cover heater and the heat-resistant layer" as recited in claim 1, or "a reflective layer between the body heater and the heat-resistant layer" as recited in claim 24.

Isaacson

On page 10 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

Isaacson is also alternatively applied to show the reflective layer.
The applicant argues that the layer (40) of Isaacson is a holder

and not a heat-resistant layer, and further argues that the examiner has based the rejection on a hindsight reconstruction. This argument is not deemed persuasive since there is no reason why this layer (40) cannot be used as a heat-resistant layer, and there is no claimed structure or support to distinguish the claimed invention from that of the applied prior art.

The Examiner has cited Isaacson to show that it was known in the art to place a reflective layer between a heater and a heat-resistant layer as recited in claims 1 and 24. However, if one of ordinary skill in the art would not have recognized that Isaacson discloses a heat-resistant layer as recited in claims 1 and 24, then Isaacson cannot teach that it was known in the art to place a reflective layer between a heater and a heat-resistant layer as recited in claims 1 and 24 as alleged by the Examiner. Here, the Examiner has taken the position that there is no reason the holder 40 in FIGS. 2 and 3 of Isaacson, which may be in the form of a picture frame holder and constructed of plastic as described in column 2, lines 46-48, of Isaacson, cannot be used as a heat-resistant layer as recited in claims 1 and 24.

However, the Examiner has not identified anything whatsoever in Isaacson or elsewhere in the prior art to indicate that one of ordinary skill in the art would have recognized that there is no reason that Isaacson's holder 40 cannot be used as a heat-resistant layer as recited in claims 1 and 24. Rather, the only suggestion that Isaacson's holder 40 can be used as a heat-resistant layer as recited in claims 1 and 24 is contained in the applicants' disclosure. Accordingly, it is submitted that the Examiner's position that there is no reason that Isaacson's holder 40 cannot be used as a heat-resistant layer as recited in claims 1 and 24 is based solely on an impermissible hindsight reconstruction of the invention arrived at by reading the applicants' disclosure.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 18 and 10 of the Appeal Brief of April 19, 2007, it is submitted that Chow and Isaacson do not disclose or suggest "a reflective layer between the cover heater and the heat-resistant layer" as recited in claim 1, or "a reflective layer between the body heater and the heat-resistant layer" as recited in claim 24.

Claims 2 and 18

On pages 10 and 11 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to claims 2 and 18, the applicant argues Chow shows the cover heater having two wires and the body heater also having two wires, and this showing, the applicant argues, does not teach single wire formed on the entire surface of the cover heater and the body heater. It is noted that the recited one single wire in the cover heater and the body heater is clearly met by one of the two wires in each of the respective cover and the body heater. , i.e., two wires in Chow shows the recited single wire. Furthermore, Chow teaches that the cover can have one or more heating elements (column 2, lines 26-29), and this teaching would also be applicable to the body heater as Chow describes the heating arrangement with respect to the cover is also applicable to the body heater (see column 5, lines 49-53).

Despite this teaching in Chow, the applicant states that Chow which "alludes" to one heating element is "an error" since Chow does not actually disclose or suggest the feature. The examiner would not speculate whether or not Chow is in error when Chow clearly teaches such heating arrangement as described in column 2, lines 26-29. The applicant also states "assuming arguendo that the apparent allusion of Chow... is not an error, [and]the mere reference to one or more heating element does not provide an enabling disclosure for a cover having one heating element." This argument is deemed not persuasive. Chow teaches one heating element, and it clearly meets the recited single wire pattern.

However, the Examiner's position that "the recited one single wire in the cover heater and the body heater is clearly met by one of the two wires in each of the respective cover and the body heater. , i.e., two wires in Chow shows the recited single wire" ignores the plain English meaning of the word "single," which is not accompanied by another or others; solitary; consisting of one part, aspect, or section: *a single thickness; a single serving*; consisting of one in number: *She had but a single thought, which was to escape. The American Heritage Dictionary of the English Language, Fourth Edition, 2006, Houghton Mifflin Company.*

Furthermore, with respect to the Examiner's statement that "the examiner would not speculate whether or not Chow is in error when Chow clearly teaches such heating arrangement as described in column 2, lines 26-29," it is submitted that the Examiner cannot

simply ignore the possibility that the statement in column 2, lines 26-29, of Chow which appears to allude to an embodiment in which a cover heater has one heating element might in fact be an error since it is inconsistent with the rest of Chow's disclosure.

Furthermore, the Examiner has not addressed the applicant's arguments on pages 20 and 21 of the Appeal brief of April 19, 2007, pointing out that column 2, lines 26-29, of Chow relied on by the Examiner relates only to Chow's cover heater, and thus does not disclose or suggest the feature "wherein the entire body heater is constituted by a single wire pattern" recited in claim 18.

Furthermore, the Examiner has not addressed the applicants' arguments on pages 21 and 22 of the Appeal Brief of April 19, 2007, pointing out that the mere reference to "one or more heating elements on that cover about such an aperture" in column 2, lines 26-29, of Chow does not provide an enabling disclosure under the guidelines set forth in MPEP 2101.1 for a cover heater having one heating element when considered in light of the fact that Chow specifically provides two heating elements in two layers to provide very good temperature uniformity as described, for example, in column 3, line 66, through column 4, line 5; column 4, lines 18-21; and column 7, lines 8-10, of Chow.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 20-22 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, and Isaacson do not disclose or suggest the feature "wherein the entire cover heater is constituted by a single wire pattern formed over the entire top surface of the cover" recited in claim 2, or the feature "wherein the entire body heater is constituted by a single wire pattern formed over at least the entire outer side wall of the main body" recited in claim 18.

Claims 7 and 25

On page 11 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to claims 7 and 25, the applicant argues that the insulating material made of pyrolytic boron nitride in Chow is not a "good heat radiation property," and that the examiner has failed to provided the basis to support the theory of inherency. The applicant further argues there are different insulating materials having different radiation property, and no theory of

inherency can be met when there is no basis in fact or technical reasoning. The applicant argue that the insulating material is disclosed as alumina, and this is not shown or taught by Chow. The applicant's argument is not deemed persuasive. It is noted that alumina as the insulating material has not been claimed, and all that is claimed by the applicant is an insulating material with no other structural support or material which does not distinguish the claimed insulating material from that of Chow in any form or shape. As discussed previously, when the structure or material recited in the reference is substantially identical as that of the claims, the claimed properties or functions are assumed inherent. All that is recited in the claims with respect to the material is that it is an insulating material with no other structure or composition. In such a broad claim, the prior art having the material made of an insulating material also meets the recited properties or functions.

However, it is submitted that the pyrolytic boron nitride of which Chow's protective layers 25' and 25 are made in fact has a poor heat radiation property, rather than a good heat radiation property as recited in claims 7 and 25, as can be seen from column 3, lines 46-50, of Shinko discussed above in connection with claims 1 and 23, which reads as follows:

The pyrolytic boron nitride coating conducts heat from the graphite bar to the metal in the cavity effectively but since pyrolytic boron nitride has low emissivity compared to the intermetallic composites now used for boats it radiates less energy.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 22-24 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, and Isaacson do not disclose or suggest the feature "wherein the insulating material forming the cover has a good heat radiation property" recited in claim 7, or the feature "wherein the insulating material forming the main body has a good heat radiation property" recited in claim 25.

Claim 9

On pages 11 and 12 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to claim 9, the applicant argues that the examiner has relied on the applicant's own disclosure to meet the recited cover heater formed in a "concentric pattern around the nozzle." This argument is not deemed persuasive. Chow teaches that its crucible can have different shapes (also see Figures 2 and

7), but more importantly Chow teaches that having an uniform heating distribution is desired when operating this device (see column 1, lines 64-67). It was pointed previously to the applicant that a concentric pattern is not a critical element and other shapes can be provided to achieve such desired uniformity. The applicant also disclose [sic] in its specification that many other shape [sic] can be had (page 6, paragraph 31). Thus, having such concentric pattern or any other shapes would have been within the level of ordinary skill in the art to provide uniform and stable heating across the cover.

Thus, the Examiner has continued to rely on the statement in paragraph [0031] of the applicants' specification that "any other patterns which can be laid over the entire top surface of the cover 40 can be applied" as justification for his proposal to modify Chow's cover heater to be "formed in a concentric pattern around the nozzle" as recited in claim 9, ignoring the applicants' arguments on pages 25 and 26 of the Appeal Brief of April 19, 2007, pointing out that such reliance is prohibited by MPEP 2143 and 2144.06. Nor has the Examiner identified anything whatsoever in Chow, Chandler, and Isaacson or elsewhere in the prior art that would have motivated one of ordinary skill in the art to modify Chow's cover heater to be "formed in a concentric pattern around the nozzle" as recited in claim 9 as proposed by the Examiner as required by MPEP 2143.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 24-27 of the Appeal Brief of April 19, 2007, it is submitted that the Examiner has not identified any motivation whatsoever in Chow, Chandler, and Isaacson or elsewhere in the prior art to modify Chow's cover heater to be "formed in a concentric pattern around the nozzle" as recited in claim 9, such that the Examiner has not established a *prima facie* case of obviousness with respect to claim 9 pursuant to MPEP 2143.

Claim 16

On page 12 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to claim 16, the applicant argues the claim as amended is not a product by process and further argues that while the heating elements of Chow is achieved via the chemical vapor deposition, the recited heating bock is rather achieved or constituted by the sprayed heat emitting material pattern. The

examiner has construed the amended claim 16 as a product by process since the structure is defined by the process of "sprayed" by which he [*sic*] heat emitting material is provided thereto.

However, assuming *arguendo* that "sprayed" as recited in claim 16 is a process as alleged by the Examiner, the Examiner has not addressed the applicants' argument on page 28 of the Appeal Brief of April 19, 2007, that Chow's heating element pattern is clearly not a "heating block" as recited in claim 16 because, as would have been understood by one of ordinary skill in the art at the time the invention was made, a "heating block" does not have a pattern. It is submitted that the "heating block" feature of claim 16 is clearly a structural limitation, rather than a product-by-process limitation, and thus was not addressed in the Examiner's explanations of the rejection, which are based solely on a product-by-process theory.

On page 12 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

And even if the claim is not deemed as a product by process, it is also noted that the chemical vapor deposition is the same method by which the heat emitting material is made (see page 7, lines 1-4 of the applicant's specification). Thus, the applicant's argument is not deemed persuasive.

The Examiner is apparently referring to paragraph [0032] on pages 6 and 7 of the applicant's specification, which reads as follows:

[0032] The cover heater 43 may be formed of platinum by screen printing. Any other materials and techniques capable of forming a thin-layered cover heater can be applied. For example, the cover heater 43 may be formed by printing a conductive paste containing metal particles and metal oxide on the surface of the cover 40 and sintering the printed conductive paste. Alternatively, a thin graphite layer may be formed on the cover 40 by chemical vapor deposition (CVD).

However, paragraph [0032] of the applicants' specification does not describe the features recited in claim 16, i.e., the features "wherein the cover heater is constituted by a sprayed heating block on the cover" and "wherein the sprayed heating block is constituted by a sprayed heat emitting material on the cover." Rather, these features are described, for example, in paragraph [0042] on pages 8 and 9 of the applicants' specification, which reads as follows:

[0042] In a heating crucible according to an embodiment of the present invention having such a structure as described above, in which a thin-layered heater is integrated into each of the cover and the main body of the heating crucible, although the heater has been described in the above embodiment as being a heating wire having a predetermined pattern, the heater may be formed as a heating block by spray coating a heat emitting material. For example, a spray-coated heater may be formed by spray coating a cover body with a heat emitting material and connecting positive and negative terminals to the cover heater, wherein the spray-coated cover heater generates heat as a predetermined voltage is applied to the positive and negative terminals via external wires. In this case, it will be appreciated that a heat-resistant layer is formed over the spray-coated heater, and that at least one thermocouple is embedded in the cover body formed of an electrically insulating ceramic material having a good thermal radiation property, such as alumina. The same spray-coated heater can be applied to the main body of a heating crucible according to another embodiment of the present invention.

Thus, the rejection of claim 16 appears to be based at least in part on a misunderstanding by the Examiner of the features recited in claim 16.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 27 and 28 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, and Isaacson do not disclose or suggest the features "wherein the cover heater is constituted by a sprayed heating block on the cover" and "wherein the sprayed heating block is constituted by a sprayed heat emitting material on the cover" recited in claim 16.

Claims 29 and 30

On page 12 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

Regarding the recited single-layer cover or body heater, the applicant argues Chow shows a three layer cover heater which includes a first and a second heating element with an insulating layer. This argument is not deemed persuasive. Chow clearly teaches that only one heating element can be used, as shown in column 2, lines 27-30, and this teaching clearly meets the recited single layer cover heater and the single layer body heater.

However, the Examiner has merely paraphrased the arguments he made on pages 10 of the Final Office Action of October 12, 2006. The Examiner has not addressed the arguments on pages 29 and 30 of the Appeal Brief of April 19, 2007, responding to the Examiner's arguments and pointing out why Chow, Chandler, and Isaacson do not disclose or suggest the features "wherein the cover heater is a single-layer cover heater" and "wherein the body heater is a single-layer body heater" recited in dependent claim 29, or the features "wherein the single-layer cover heater is the only cover heater on the cover" and "wherein the single-layer body heater is the only body heater on the main body" recited in dependent claim 30.

Accordingly for at least the foregoing reasons and the reasons discussed on pages 28-30 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, and Isaacson do not disclose or suggest the features "wherein the cover heater is a single-layer cover heater" and "wherein the body heater is a single-layer body heater" recited in claim 29, or the features "wherein the single-layer cover heater is the only cover heater on the cover" and "wherein the single-layer body heater is the only body heater on the main body" recited in claim 30.

Conclusion—Rejection 1

For at least the foregoing reasons and the reasons discussed on pages 10-31 of the Appeal Brief of April 19, 2007, it is respectfully requested that the rejection of claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31 under 35 USC 103(a) as being unpatentable over Chow in view of Chandler or Isaacson be reversed.

Rejection 4—Claim 10

On page 13 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to Okuda regarding the recited metal particles and metal oxide, the applicant argues that the metal nitride or carbide particles of Okuda do not meet the recited "metal particles". The applicant further states while Okuda shows the conductive pastes comprising metal nitrides/carbide particles with metal oxide, such composition does not meet the recited "metal particles and metal oxides." The applicant argues it is unreasonable to interpret the metal carbide/nitride particles which includes nonmetal carbon or nitrogen can be "metal particles".

This argument is not deemed persuasive. The recited conductive paste comprising the metal particles and metal oxide clearly read on the composition of Okuda which includes the particles including metals, nonmetal and metal oxides, i.e., the recited composition is a subset of the Okuda composition. It is furthermore noted that the use of the open ended transitional phrase "comprising" allows the recited metal particles to include not only metals but also un-recited elements including nonmetal as well. This is not an unreasonable interpretation of the claim.

However, with respect to the Examiner's statement that "the use of the open ended transitional phrase 'comprising' allows the recited metal particles to include not only metals but also un-recited elements including nonmetal as well," claim 10 actually recites "wherein the conductive paste comprises metal particles and metal oxide." Although the use of the open-ended transitional phrase "comprises" allows the conductive paste "to include not only metals but also un-recited elements including nonmetal as well," it does not allow the metal particles "to include not only metals but also un-recited elements including nonmetal as well." The term "metal particles" is a closed term that excludes the metal nitride particles (TiN) and the metal carbide particles (WC) disclosed by Okuda that the Examiner considers to correspond to the "metal particles" recited in claim 10. Thus, the Examiner has improperly interpreted claim 10 as if it recited "wherein the conductive paste comprises (1) particles comprising metal and (2) metal oxide. It is submitted that Okuda does not disclose a conductive paste that comprises the combination of "metal particles and metal oxides" recited in claim 10 for the reasons discussed on pages 32-35 of the Appeal Brief of April 19, 2007.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 32-35 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, Isaacson, and Okuda do not disclose or suggest the features "wherein the cover heater is constituted by a sintered printed conductive paste on the cover" and "wherein the conductive paste comprises metal particles and metal oxide" recited in claim 10, and it is respectfully requested that the rejection of claim 10 under 35 USC 103(a) as being unpatentable over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 20-25, and 29 (presumably intended to be claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31), and further in view of Okuda, be reversed.

Rejection 6—Claim 27

On page 13 of the Examiner's Answer of July 24, 2007, the Examiner states as follows:

With respect to the recited "convergent-divergent nozzle", the applicant argues Chow does not show such nozzle. Figure 7 of Chow clearly shows a nozzle with a smaller opening lead to a large opening constitutes the convergent-divergent nozzle, i.e., the nozzle 19' of Chow which widens into a larger opening allows a divergent pattern. The Chen and Murakami references are also shown that such convergent-divergent nozzle is well known in the art.

However, it is submitted that the nozzle 19' in FIG. 7 of Chow is not a convergent-divergent nozzle as recited in claim 27 as alleged by the Examiner because it has only a divergent portion and does not have a convergent portion. Furthermore, the Examiner has not addressed the arguments on pages 36-38 of the Appeal Brief of April 19, 2007, pointing out why it would not have been obvious to replace Chow's nozzle 19' with the convergent-divergent nozzle disclosed by Chen or Murakami as proposed by the Examiner.

Accordingly, for at least the foregoing reasons and the reasons discussed on pages 36-38 of the Appeal Brief of April 19, 2007, it is submitted that Chow, Chandler, Isaacson, Chen, and Murakami do not disclose or suggest the feature "wherein the nozzle is a convergent-divergent nozzle through which the gaseous organic substance comes out from the main body in a diverging pattern, thereby enabling the heating crucible to produce a diverging pattern of the gaseous organic substance" recited in claim 27, and it is respectfully requested that the rejection of claim 27 under 35 USC 103(a) as being unpatentable over Chow in view of Chandler or Isaacson as applied to claims 1, 2, 4, 7, 9, 11-13, 16-18, 21-25, and 29-31, and further in view of Chen or Murakami, be reversed.

Conclusion—Argument

In view of the law and the facts stated herein and in the Appeal Brief of April 19, 2007, it is submitted that the various combinations of Chow, Chandler, Isaacson, Kano, Bichrt, Okuda, Takagi, Chen, and Murakami relied on by the Examiner do not disclose or suggest all of the features recited in claims 1-4, 7-27, and 29-31.

Accordingly, it is respectfully requested that the rejections of claims 1-4, 7-27, and 29-31 under 35 USC 103(a) as being unpatentable over the various combinations of Chow, Chandler, Isaacson, Kano, Bichrt, Okuda, Takagi, Chen, and Murakami relied on by the Examiner be reversed.

If there are any additional fees associated with the filing of this paper, please charge the same to our Deposit Account No. 503333.


Respectfully submitted,

STEIN, MCEWEN & BUI, LLP

Date:

09/18/07

By:


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VIII. CLAIMS APPENDIX (UPDATED)

This Claims Appendix presumes that the Amendment After Appeal Under 37 CFR 41.33(b)(2) rewriting allowable claim 28 in independent form has been entered.

1. (Previously presented) A heating crucible for an organic thin film forming apparatus, the heating crucible comprising:

- a main body in which to contain an organic substance;
- a cover provided on the main body, the cover formed of an insulating material and having a nozzle through which a gaseous organic substance comes out from the main body;
- a cover heater formed as a thin film type on the top surface of the cover;
- a heat-resistant layer formed on a surface of the cover heater;
- a reflective layer between the cover heater and the heat-resistant layer; and
- a body heater heating the main body.

2. (Previously presented) The heating crucible of claim 1, wherein the entire cover heater is constituted by a single wire pattern formed over the entire top surface of the cover, the single wire pattern of the entire cover heater having a positive terminal at a first end of the single wire pattern and a negative terminal at a second end of the single wire pattern.

3. (Previously presented) The heating crucible of claim 2, wherein the single wire pattern of the cover heater is constituted by printed platinum on the cover.

4. (Original) The heating crucible of claim 1, wherein the cover further comprises at least one embedded thermocouple.

5.-6. (Canceled)

7. (Original) The heating crucible of claim 1, wherein the insulating material forming the cover has a good heat radiation property.

8. (Original) The heating crucible of claim 7, wherein the cover is formed of alumina.

9. (Original) The heating crucible of claim 1, wherein the cover heater is formed in a concentric pattern around the nozzle.

10. (Previously presented) The heating crucible of claim 1, wherein the cover heater is constituted by a sintered printed conductive paste on the cover; and
wherein the conductive paste comprises metal particles and metal oxide.

11. (Previously presented) The heating crucible of claim 1, wherein the cover heater is constituted by a thin chemical vapor deposition graphite layer on the cover.

12. (Previously presented) The heating crucible of claim 1, wherein the insulating material forming the cover comprises a thermally conductive ceramic material.

13. (Previously presented) The heating crucible of claim 12, wherein the thermally conductive ceramic material comprises a ceramic nitride or a ceramic carbide.

14. (Original) The heating crucible of claim 13, wherein the ceramic nitride is aluminum nitride.

15. (Original) The heating crucible of claim 13, wherein the ceramic carbide is silicon carbide.

16. (Previously presented) The heating crucible of claim 1, wherein the cover heater is constituted by a sprayed heating block on the cover; and
wherein the sprayed heating block is constituted by a sprayed heat emitting material on the cover.

17. (Previously presented) The heating crucible of claim 1, wherein the main body is formed of the same insulating material forming the cover; and
wherein the body heater is formed as a thin film type on the outer wall of the main body.

18. (Previously presented) The heating crucible of claim 17, wherein the entire body heater is constituted by a single wire pattern formed over at least the entire outer side wall of the main body, the single wire pattern of the entire body heater having a positive terminal at a first end of the single wire pattern and a negative terminal at a second end of the single wire pattern.

19. (Previously presented) The heating crucible of claim 18, wherein the single wire pattern of the body heater is constituted by printed platinum on the body.

20. (Previously presented) The heating crucible of claim 18, wherein the single wire pattern of the body heater is further formed on the entire outer bottom wall of the main body.

21. (Original) The heating crucible of claim 17, wherein the insulating material forming the main body is a ceramic material.

22. (Original) The heating crucible of claim 17, wherein the main body further comprises at least one embedded thermocouple.

23. (Original) The heating crucible of claim 17, further comprising a heat-resistant layer on the surface of the body heater.

24. (Original) The heating crucible of claim 23, further comprising a reflective layer between the body heater and the heat-resistant layer.

25. (Original) The heating crucible of claim 17, wherein the insulating material forming the main body has a good heat radiation property.

26. (Original) The heating crucible of claim 25, wherein the main body is formed of alumina.

27. (Previously presented) The heating crucible of claim 1, wherein the nozzle is a convergent-divergent nozzle through which the gaseous organic substance comes out from the

main body in a diverging pattern, thereby enabling the heating crucible to produce a diverging pattern of the gaseous organic substance.

28. (Previously presented) A heating crucible for an organic thin film forming apparatus, the heating crucible comprising:

a main body in which to contain an organic substance;

a cover provided on the main body, the cover formed of an insulating material and having a nozzle through which a gaseous organic substance comes out from the main body;

a cover heater formed as a thin film type on the top surface of the cover;

a heat-resistant layer formed on a surface of the cover heater;

a reflective layer between the cover heater and the heat-resistant layer; and

a body heater heating the main body;

wherein the nozzle extends from a surface of the cover facing toward the main body to a surface of the heat-resistant layer facing away from the main body;

wherein an entry opening of the nozzle through which the gaseous organic substance enters the nozzle is flush with the surface of the cover facing toward the main body;

wherein an exit opening of the nozzle through which the gaseous organic substance exits from the nozzle is flush with the surface of the heat-resistant layer facing away from the main body; and

wherein the nozzle converges from the entry opening to a throat of the nozzle at a junction between the cover and the heat-resistant layer, and diverges from the throat of the nozzle to the exit opening.

29. (Previously presented) The heating crucible of claim 1, wherein the cover heater is a single-layer cover heater; and

wherein the body heater is a single-layer body heater.

30. (Previously presented) The heating crucible of claim 29, wherein the single-layer cover heater is the only cover heater on the cover; and

wherein the single-layer body heater is the only body heater on the main body.

31. (Previously presented) The heating crucible of claim 1, wherein the heat-resistant layer blocks heat generated by the cover heater from being transferred outside the heating crucible.

IX. EVIDENCE APPENDIX (UPDATED)

1. Chandler (U.S. Patent No. 2,799,764) cited by the Examiner in the Office Action of June 22, 2005.
2. Isaacson et al. (U.S. Patent No. 3,842,241) cited by the Examiner in the Office Action of June 22, 2005.
3. Okuda et al. (U.S. Patent No. 4,804,823) cited by the Examiner in the Office Action of September 8, 2004.
4. Takagi (U.S. Patent No. 4,217,855) cited by the Examiner in the Final Office Action of October 12, 2006.
5. Chow (U.S. Patent No. 5,157,240) cited by the Examiner in the Office Action of September 8, 2004.
6. Murakami et al. (U.S. Patent No. 5,728,223) cited by the Examiner in the Office Action of May 2, 2006.
7. Chen et al. (U.S. Patent No. 6,024,799) cited by the Examiner in the Office Action of May 2, 2006.
8. Bichrt (U.S. Patent No. 6,162,300) cited by the Examiner in the Office Action of September 8, 2004.
9. Kano et al. (U.S. Patent No. 6,242,719) cited by the Examiner in the Office Action of September 8, 2004.
10. Interview Summary for the personal interview between Primary Examiner Sang Yeop Paik and the applicant's attorney Randall S. Svihla conducted on December 28, 2006.
11. English translation of Korean Patent Application No. 2002-52898 filed on September 3, 2002, the Korean priority application of the present application, submitted on April 19, 2007.
12. Colombo et al. (U.S. Patent No. 6,030,458) cited by the Examiner in the Examiner's Answer of July 24, 2007.
13. Yamashita et al. (U.S. Patent No. 5,034,200) cited by the Examiner in the Examiner's Answer of July 24, 2007.

14. Hüther et al. (U.S. Patent No. 4,511,612) cited by the Examiner in the Examiner's Answer of July 24, 2007.
15. Shinko (U.S. Patent No. 4,264,803) cited by the applicants in this Reply Brief.
16. Pyrolytic boron nitride data (14 pages) downloaded on August 23, 2007, from the Morgan Advanced Ceramics Web site at <http://www.morganadvancedceramics.com/materials/pbn.htm> cited by the applicants in this Reply Brief (copy attached following page 33 of this Reply Brief).



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Pyrolytic Boron Nitride

Pyrolytic Boron Nitride

PYROLITIC BORON NITRIDE

Typical characteristics include:

High thermal conductivity
Low thermal expansion
Good thermal shock resistance
High electrical resistance
Low dielectric constant and loss tangent
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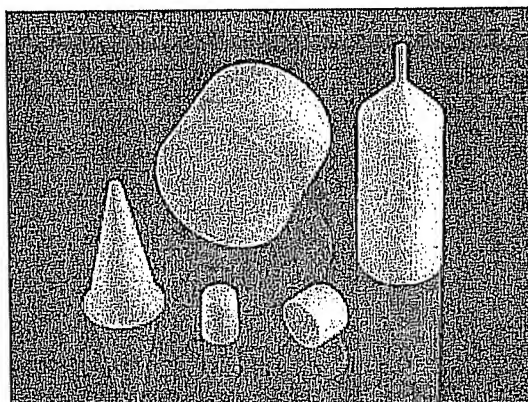
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- Good thermal conductivity
- High insulation resistance
- High dielectric strength over wide temperature ranges.
- Extremely pure
- Non-wetting
- Non-toxic
- Non-reactive to most other compounds
- Withstands high temperatures and rapid cooling

Performance PBN will not react with acids, alkalis, organic solvents, molten metals, or graphite. Bulk impurity levels are less than 100 parts per million with metallic impurities less than 10 parts per million. It withstands 1800° C in vacuum and 2000° C in nitrogen, showing no melting point, making it an excellent choice for furnace components and melting vessels. Crucibles heated to 1200° C can be plunged into liquid nitrogen without visible damage. PBN-coated graphite heating elements

provide extremely uniform temperature profiles for both compound and silicon semiconductor manufacturing.

The anisotropic conductivity of Performance PBN improves process performance for crystal growth, whether the growth method is Liquid Encapsulated Czochralski (LEC), Vertical Gradient Freeze (VGF), or Bridgman. The high purity and physical stability of this unique material also make it the best choice for auxiliary effusion cell hardware use.

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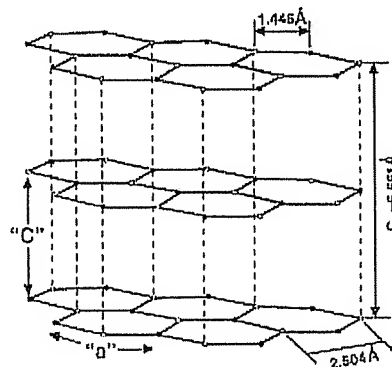


Physical Properties of Performance PBN™

Performance PBN is a non-porous, opaque material with mechanical properties that are actually enhanced at high temperatures. Its crystalline structure- consisting of layers of hexagons composed of boron and nitrogen atoms stacked on top of each other in parallel planes-gives it good flexural strength, high compression strength and high fracture resistance. The bonds between the boron and nitrogen atoms vary with crystal direction, giving Performance PBN anisotropic properties. In each ring in the planar ("a") direction, the nitrogen and boron atoms bond covalently. In the perpendicular ("c") direction, the bonds are formed by the weaker van der Waal's forces.

Directional Properties of PBN

Property	"a" Direction	"c" Direction
Thermal Conductivity	Good	Low
Electrical Resistivity	High	Highest
Thermal Expansion	Low	24X "a" Direction
Compressive Strength	High (High Tensile Strength also)	High
Dielectric Constant	Moderate	Low
Loss Tangent	Low	Low



- Boron
- Nitrogen

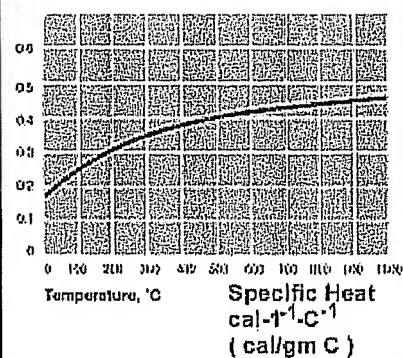
Pyrolytic Boron Nitride's Hexagonal Structure

Summary of Mechanical Properties

PROPERTY	VALUE
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Average Density	2.185 g/cc
Gas Permeability (Helium)	2×10^{-11} cm ² /sec
Compression Strength "a" Direction @25°C	37,000 PSI
Compression Strength "a" Direction @1200°C	35,000 PSI
Compression Strength "c" Direction @25°C	48,000 PSI
Compression Strength "c" Direction @1200°C	54,000 PSI
Tensile Strength "a" Direction @25°C	21,000 PSI
Flexural Strength @25°C	28,000 PSI
Flexural Strength @1200°C	27,000 PSI
Torsional Shear Strength @25°C	93,000 PSI
Young's Modulus "a" Direction @25°C	3.4×10^6
Poisson's Ratio "a" Direction @25°C	.086
Flexural Modulus @25°C	3.2×10^6 PSI
Flexural Modulus @1200°C	3.2×10^6 PSI
Hardness Taken on surface of "a" plane Knoop Hardness #	75
"a" Directional Compressive Stress vs. Strain	<p>Stress (KPSI)</p> <p>Strain (%) In Addition to Strain at 20 KPSI Stress (KPSI)</p>

Specific Heat vs. Temperature



Properties of Performance PBN

[Physical](#)

[Thermal](#)

[Chemical / Electrical](#)

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Morgan Advanced Ceramics Inc, CVD Materials
 4 Park Avenue, Hudson, New Hampshire 03051-3927 USA
 Phone (603) 598-9122 • Toll Free (800) 700-1283 • Fax (603) 598-9126

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Did you know...
that CVD Materials help to
power hybrid cars?



Thermal Properties Of Performance PBN

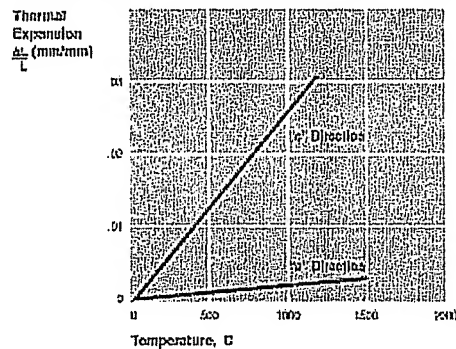
Summary of Thermal Properties

PROPERTY	VALUE
Thermal Conductivity "a" Direction @25°C	0.25 cal/cm•sec•°C
Thermal Conductivity "a" Direction @500°C	0.17 cal/cm•sec•°C
Thermal Conductivity "a" Direction @1000°C	0.15 cal/cm•sec•°C
Thermal Conductivity "c" Direction @25°C	0.004 cal/cm•sec•°C
Thermal Conductivity "c" Direction @500°C	0.005 cal/cm•sec•°C
Thermal Conductivity "c" Direction @1000°C	0.006 cal/cm•sec•°C
Thermal Expansion "a" Direction @500°C	0.001 mm/mm
Thermal Expansion "a" Direction @1000°C	0.0025 mm/mm
Thermal Expansion "c" Direction @500°C	0.013 mm/mm
Thermal Expansion "c" Direction @1000°C	0.027 mm/mm
Coefficient of Thermal Expansion "a" Direction above @500°C	3×10^{-6} mm/mm•°C
Coefficient of Thermal Expansion "c" Direction @500°C	30×10^{-6} mm/mm•°C
Resistance to Thermal Shock: 1200°C into Liquid Nitrogen	no damage
Specific Heat @25°C	0.2 cal/gm•°C
Specific Heat @500°C	0.4 cal/gm•°C
Specific Heat @1000°C	0.47 cal/gm•°C

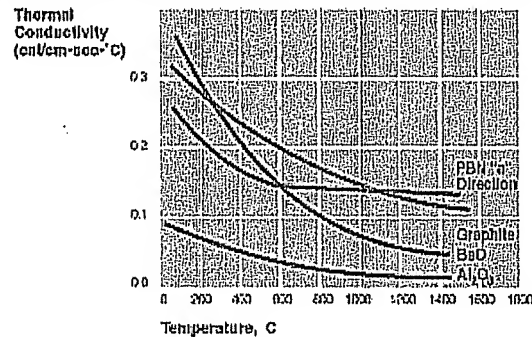
Performance PBN shows no melting point. It can withstand 1800° C in vacuum and 2000° C in nitrogen. This makes it an excellent choice for furnace components and melting vessels. Performance PBN is resistant to thermal shock. Crucibles heated to 1200° C can be plunged into liquid nitrogen without visible damage.

Performance PBN's thermal conductivity in the "a" direction is similar to that of cast iron, surpassing that of beryllia. For this reason, the compound can conduct heat while acting as an electrical insulator. Thermal conductivity in the "a" direction is almost 66 times greater than thermal conductivity in the "c" direction. Conductivity in the "c" direction increases slightly with increasing temperatures.

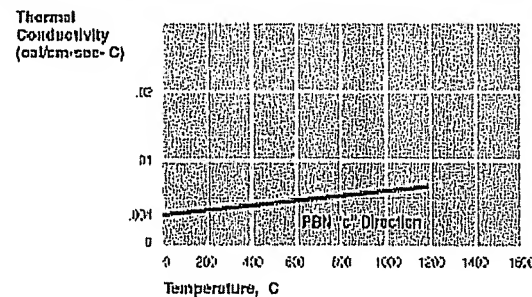
Thermal Expansion vs. Temperature



Thermal Conductivity vs. Temperature "a" Direction



Thermal Conductivity vs. Temperature "c" Direction



Properties of Performance PBN

[Physical](#)

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Chemical Properties Of Performance PBN

Performance PBN is non-toxic, non-wetting and inert to nearly all other compounds. It will not react with acids, alkalies, organic solvents, molten metals or graphite. Performance PBN is extremely pure. Bulk impurity levels are less than 100 parts per million with metallic impurities less than 10 parts per million.

Summary of Chemical Purity Data

PROPERTY	VALUE
Non Toxic	
Non Porous	
Non Wetting	
Total Impurities	<100 ppm
Metallic Impurities Typical Elements	
Ca	< 1 ppm
Al	< 1 ppm
Mg	< 1 ppm
Ti	< 1 ppm
Cu	< 1 ppm
Si	< 5 ppm
Total Metallic	< 10 ppm
Total Carbon (by LECO WR-12)	< 100 ppm
Oxidation Rate Standard Air @700°C	1.8×10^{-5} mg/cm ² ·min
Oxidation Rate Standard Air @900°C	3.8×10^{-4} mg/cm ² ·min
Oxidation Rate Standard Air @1200°C	1.6×10^{-2} mg/cm ² ·min
Outgassing Total System Pressure 1300° C, System Base	< 1×10^{-10} Torr

Pressure 1 x 10 ⁻¹⁰ Torr	
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Summary of Electrical Properties

PROPERTY	VALUE
Resistivity "a" and "c" Directions @25°C	1 x 10 ¹⁵ ohm•cm
Resistivity "a" Direction @1000°C	3 x 10 ⁷ ohm•cm
Resistivity "a" Direction @1500°C	1 x 10 ⁴ ohm•cm
Resistivity "c" Direction @1000°C	5 x 10 ⁹ ohm•cm
Resistivity "c" Direction @1500°C	3 x 10 ⁵ ohm•cm
Dielectric Strength "c" Direction @25°C	2 x 10 ⁵ VDC/mm
Dielectric Constant @ 8GHz "a" Direction @25°C	4.97
Dielectric Constant @ 8GHz "a" Direction @1200°C	5.07
Dielectric Constant @ 8GHz "c" Direction @25°C	3.67
Dielectric Constant @ 8GHz "c" Direction @1200°C	3.75
Loss Tangent "a" and "c" Directions, @25°C to 600°C 1KHz to 12 GHz	< 9 x 10 ⁻⁴
Loss Tangent "a" and "c" Directions, @1200°C, 12 GHz	.001

Properties of Performance PBN[Physical](#)[Thermal](#)[Chemical / Electrical](#)

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Technical Data Sheet

Pyrolytic Boron Nitride (a-PBN)

Performance PBN

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Description

Non-porous, opaque material with mechanical properties that are enhanced at high temperatures. Anisotropic properties are due to the bonds between boron and nitrogen atoms varying with crystal direction.

Prime features

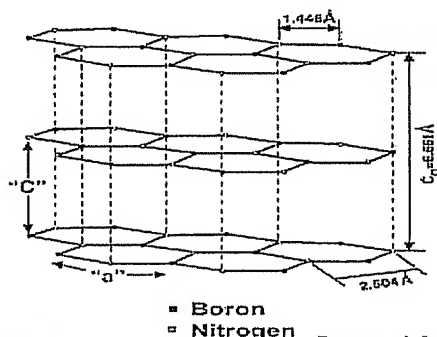
- Good flexural strength, high compressive strength and high fracture resistance.
- Anisotropic properties.
- High "a" direction thermal conductivity
- Conducts heat while acting as an electrical insulator.
- High dielectric strength over wide range of temperatures
- High temperature applications
- Non-toxic.
- Non-wetting.
- Inert to most acids, alkalis, organic solvents, molten metals and graphite
- High purity
- Oxidation and chemical resistance
- Low outgasing
- Excellent thermal shock resistance
- Opaque

Typical applications

- Crystal Growth, including GaAs and InP
- LEC, VGF and Bridgman crucibles
- MBE crucibles
- SUMO crucibles
- MBE furniture
- Auxiliary effusion cell hardware
- Heating elements

MAC production capabilities

- Chemical vapor deposition (CVD).
- High volume LEC capability.
- CNC grinding and lapping to very tight tolerances.
- PBN polishing
- Prototype, batch and volume production.



Physical Properties

Bulk density, g/cc	2.185
Gas Permeability (Helium), cm ² /sec	2x10 ⁻¹¹
Compression Strength, PSI	
"a" direction @ 25°C	37,000
@ 1200°C	35,000
"c" direction @ 25°C	48,000
@ 1200°C	54,000
Tensile Strength, PSI	
"a" direction @ 25°C	21,000
Flexural Strength, PSI	
@ 25°C	28,000
@ 1200°C	27,000
Torsional Shear Strength, PSI	
@ 25°C	93,000
Young's Modulus	
"a" direction @ 25°C	3.4 x 10 ⁶
Poisson's Ratio	
"a" direction @ 25°C	0.086
Flexural Modulus, PSI	
@ 25°C	3.2x10 ⁵
@ 1200°C	3.2x10 ⁵
Thermal Conductivity, cal/cm*sec*°C	
"a" direction @ 25°C	0.25
@ 500°C	0.17
@ 1000°C	0.15
"c" direction @ 25°C	0.004
@ 500°C	0.005
@ 1000°C	0.006
Thermal Expansion, mm/mm	
"a" direction @ 500°C	0.001
@ 1000°C	0.0025
"c" direction @ 500°C	0.013
@ 1000°C	0.027
Coefficient of Thermal Expansion, mm/mm*°C	
"a" direction > 500°C	3x10 ⁻⁶
"c" direction @ 500°C	30x10 ⁻⁶
Specific Heat, cal/gm*°C	
@ 25°C	0.2
@ 500°C	0.4
@ 1000°C	0.47
Resistivity, ohm*cm	
"a" direction @ 25°C	1x10 ¹⁵
@ 1000°C	3x10 ⁷
@ 1500°C	1x10 ⁴
"c" direction @ 25°C	1x10 ¹⁵
@ 1000°C	5x10 ⁹
@ 1500°C	3x10 ⁵

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Morgan Advanced Ceramics, Inc., CVD Materials Division
4 Park Avenue, Hudson, NH 03051, 603-698-9122

Please note that all values quoted are based on test pieces and may vary according to component design. These values are not guaranteed in any way and should only be treated as indicative values. They should be used for guidance only and for no other purpose whatsoever.